Time Value of Money

Appendix B

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Fundamental Accounting Principles

25th Edition

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Appendix B Learning Objectives

CONCEPTUAL

C1 Describe the earning of interest and the concepts of present and future values.

PROCEDURAL

P1 Apply present value concepts to a single amount by using interest tables.

P2 Apply future value concepts to a single amount by using interest tables.

P3 Apply present value concepts to an annuity by using interest tables.

P4 Apply future value concepts to an annuity by using interest tables.

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Learning Objective C1

Describe the earning of interest and the concepts of present and future values.

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Present and Future Value Concepts

- Value of assets and liabilities change over time.
- Change is due to interest.
- Example: Cash in savings earns interest.
- Present and future value computations help us measure interest over time.
  - Present value used to determine value of future-day assets today.
  - Future value used to determine value of present-day assets at a future date.

Learning Objective C1: Describe the earning of interest and the concepts of present and future values.

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Learning Objective P1

Apply present value concepts to a single amount by using interest tables.

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Present Value of a Single Amount for One Period

Exhibit B.2

Formula to compute present value of a single amount:

- p = present value (PV)
- f = future value (FV)
- i = interest rate per period
- n = number of periods

$$p = \frac{f}{(1+i)^n}$$

Illustration of PV of a Single Amount for One Period:

- p = $200
- f = $220
- i = 10%
- n = 1

$$p = \frac{f}{(1+i)^n} = \frac{\$220}{(1+0.10)^1} = \$200$$

Learning Objective P1: Apply present value concepts to a single amount by using interest tables.

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Present Value of a Single Amount for Multiple Periods

Exhibit B.2

Formula to compute present value of a single amount:

- p = present value (PV)
- f = future value (FV)
- i = interest rate per period
- n = number of periods

$$p = \frac{f}{(1+i)^n}$$

Illustration of PV of a Single Amount for Multiple Periods:

- p = \$200
- f = \$242
- i = 10%
- n = 2

$$p = \frac{f}{(1+i)^n} = \frac{\$242}{(1+0.10)^2} = \$200$$

Learning Objective P1: Apply present value concepts to a single amount by using interest tables.

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Using Present Value Table to Compute PV of a Single Amount

Exhibit B.3

- Present value table helps with computations.
- Provides present values (factors) for variety of interest rates and periods.
- Present value assumes that the future value equals 1.
- Present value of 1 table – Table B.1
- Formula to compute present value of a single amount:
  - p = present value (PV)
  - i = interest rate per period
  - n = number of periods

$$p = \frac{1}{(1+i)^n}$$

Learning Objective P1: Apply present value concepts to a single amount by using interest tables.

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Present Value Table to Compute PV of 1

- Case 1: solve for *p* of $220 when knowing *i* = 10% and *n* = *1*.
  - Table B.1: row for one period and column for 10%
  - *p* = 0.9091
  - *p* = $220 × 0.9091 = $200
- Case 2: solve for *n* when knowing *i* = 12%= and *p* =*$13,000*; Want $100,000 in *n* years and have $13,000 today.
  - $13,000 / $100,000 = 0.1300
  - Table B.1: find value nearest to 0.1300 in 12% column
  - *n* = 18 periods or 18 years
- Case 3: solve for *i* when knowing *p = $60,000* and *n = 9*; Want $120,000 in 9 years and have $60,000 today.
  - $60,000 / $120,00 = 0.5000
  - Table B.1: find nearest value to 0.5000 in row 9
  - *i* = 8%

Learning Objective P1: Apply present value concepts to a single amount by using interest tables.

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Learning Objective P2

Apply future value concepts to a single amount by using interest tables.

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Future Value of a Single Amount for One Period

Exhibit B.4

Formula to compute future value of a single amount:

- p = present value (PV)
- f = future value (FV)
- i = interest rate per period
- n = number of periods

$$f = p \times (1 + i)^n$$

Illustration of FV of a Single Amount for One Period:

- p = \$200
- f = \$220
- i = 10%
- n = 1

$$f = p \times (1 + i)^n$$
$$= \$200 \times (1 + 0.10)^1$$
$$= \$220$$

Learning Objective P2: Apply future value concepts to a single amount by using interest tables.

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Future Value of a Single Amount for Multiple Periods

Exhibit B.4

Formula to compute future value of a single amount:

- p = present value (PV)
- f = future value (FV)
- i = interest rate per period
- n = number of periods

$$f = p \times (1+i)^n$$

Illustration of FV of a Single Amount for Multiple Periods:

- p = \$200
- f = \$266.20
- i = 10%
- n = 3

$$f = p \times (1+i)^n$$
$$= \$200 \times (1+0.10)^3$$
$$= \$200 \times 1.3310$$
$$= \$266.20$$

Learning Objective P2: Apply future value concepts to a single amount by using interest tables.

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Using Present Table to Compute FV of a Single Amount

Exhibit B.5

- Future value table helps with computations.
- Provides future values (factors) for variety of interest rates and periods.
- Future value assumes that the present value equals 1.
- Future value of 1 table - Table B.2.
- Formula to compute present value of a single amount:

$$f = (1 + i)^n$$

  - f = future value (FV)
  - i = interest rate per period
  - n = number of periods

Learning Objective P2: Apply future value concepts to a single amount by using interest tables.

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Future Value Table to Compute PV of 1

Case 1: solve for *f* when knowing *i* = 12% and *n = 5;* Invest $100 for five years at 12%.

- Table B.2: row for five periods and column for 12%.
- *f* = 1.7623
- *f* = $100 × 1.7623 = $176.23 ($176.24 rounded)

Case 2: solve for *n* when knowing *i* = 7%= and *f =$3,000*; Have $2,000 and want $3,000 in *n* years at 7%.

- $3,000 / $2,000 = 1.500
- Table B.2: look in 7% column and find value nearest to 1.500
- *n* = 6 periods or 6 years

Case 3: solve for *i* when knowing *f = $4,000* and *n = 9*; Have $2,001 and want $4,000 in 9 years.

- $4,000 / $2,001 = 1.9990
- Table B.2: row 9 find nearest value to 1.9990
- *i* = 8%

Learning Objective P2: Apply future value concepts to a single amount by using interest tables.

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Learning Objective P3

Apply present value concepts to an annuity by using interest tables.

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Present Value of an Annuity

- Annuity – series of equal payments occurring at equal intervals.
- Ordinary annuity – equal end-of-period payments at equal intervals.
- Can compute PV of ordinary annuity using Table B.1.
- Direct way use PV of annuity table – Table B.3.
- Exam

From Table B.1		From Table B.3	
$i = 15\%, n = 1$	0.8696		
$i = 15\%, n = 2$	0.7561		
$i = 15\%, n = 3$	0.6575		
Total	2.2832	$i = 15\%, n = 3$	2.2832

Learning Objecti
interest tables.

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Learning Objective P4

Apply future value concepts to an annuity by using interest tables.

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Future Value of an Annuity

- Can compute FV of ordinary annuity using Table B.2.
- Direct way use FV of annuity table – Table B.4.
- Example of using Table B.2 vs Table B.4:

From Table B.2		From Table B.4	
$i = 15\%, n = 0$	1.0000		
$i = 15\%, n = 1$	1.1500		
$i = 15\%, n = 2$	1.3225		
Total	3.4725	$i = 15\%, n = 3$	3.4725

Learning Objective P4: Apply future value concepts to an annuity by using interest tables.

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Table B.1 Present Value of 1 (1)

TABLE B.1

Present Value of 1

$$P = 1/(1+i)^n$$

Periods	Rate											
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	15%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.8929	0.8696
2	0.9803	0.9612	0.9426	0.9246	0.9070	0.8900	0.8734	0.8573	0.8417	0.8264	0.7972	0.7561
3	0.9706	0.9423	0.9151	0.8890	0.8638	0.8396	0.8163	0.7938	0.7722	0.7513	0.7118	0.6575
4	0.9610	0.9238	0.8885	0.8548	0.8227	0.7921	0.7629	0.7350	0.7084	0.6830	0.6355	0.5718
5	0.9515	0.9057	0.8626	0.8219	0.7835	0.7473	0.7130	0.6806	0.6499	0.6209	0.5674	0.4972
6	0.9420	0.8880	0.8375	0.7903	0.7462	0.7050	0.6663	0.6302	0.5963	0.5645	0.5066	0.4323
7	0.9327	0.8706	0.8131	0.7599	0.7107	0.6651	0.6227	0.5835	0.5470	0.5132	0.4523	0.3759
8	0.9235	0.8535	0.7894	0.7307	0.6768	0.6274	0.5820	0.5403	0.5019	0.4665	0.4039	0.3269
9	0.9143	0.8368	0.7664	0.7026	0.6446	0.5919	0.5439	0.5002	0.4604	0.4241	0.3606	0.2843
10	0.9053	0.8203	0.7441	0.6756	0.6139	0.5584	0.5083	0.4632	0.4224	0.3855	0.3220	0.2472
11	0.8963	0.8043	0.7224	0.6496	0.5847	0.5268	0.4751	0.4289	0.3875	0.3505	0.2875	0.2149
12	0.8874	0.7885	0.7014	0.6246	0.5568	0.4970	0.4440	0.3971	0.3555	0.3186	0.2567	0.1869
	0.878	0.773	0.681	0.600	0.530		0.415	0.367	0.326	0.289	0.229	0.162

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Table B.1 Present Value of 1 (2)

Periods	Rate											
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	15%
16	0.8528	0.7284	0.6232	0.5339	0.4581	0.3936	0.3387	0.2919	0.2519	0.2176	0.1631	0.1069
17	0.8444	0.7142	0.6050	0.5134	0.4363	0.3714	0.3166	0.2703	0231 1	0.1978	0.1456	0.0929
18	0 .8360	0 .7002	0 .5874	0 .4936	0 .4155	0 .3503	0 .2959	0 .2502	0 .2120	0 .1799	0 .1300	0 .0808
19	0 .8277	0 .6864	0 .5703	0 .4746	0 .3957	0 .3305	0 .2765	0 .2317	0 .1945	0 .1635	0 .1161	0 .0703
20	0 .8195	0 .6730	0 .5537	0 .4564	0 .3769	0 .3118	0 .2584	0 .2145	0 .1784	0 .1486	0 .1037	0 .0611
25	0 .7798	0 .6095	0 .4776	0 .3751	0 .2953	0 .2330	0 .1842	0 .1460	0 .1160	0 .0923	0 .0588	0 .0304
30	0 .7419	0 .5521	0 .4120	0 .3083	0 .2314	0 .1741	0 .1314	0 .0994	0 .0754	0 .0573	0 .0334	0 .0151
35	0 .7059	0 .5000	0 .3554	0 .2534	0 .1813	0 .1301	0 .0937	0 .0676	0 .0490	0 .0356	0 .0189	0 .0075
40	0 .6717	0 .4529	0 .3066	0 .2083	0 .1420	0 .0972	0 .0668	0 .0460	0 .0318	0 .0221	0 .0107	0 .0037

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Table B.2 Future Value of 1 (1)

TABLE B.2

Future Value of 1

$$fi=(1+\ )^{n}$$

Periods	Rate											
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	15%
0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	1.0100	1.0200	1.0300	1.0400	1.0500	1.0600	1.0700	1.0800	1.0900	1.1000	1.1200	1.1500
2	1.0201	1.0404	1.0609	1.0816	1.1025	1.1236	1.1449	1.1664	1.1881	1.2100	1.2544	1.3225
3	1.0303	1.0612	1.0927	1.1249	1.1576	1.1910	1.2250	1.2597	1.2950	1.3310	1.4049	1.5209
4	1.0406	1.0824	1.1255	1.1699	1.2155	1.2625	1.3108	1.3605	1.4116	1.4641	1.5735	1.7490
5	1.0510	1.1041	1.1593	1.2167	1.2763	1.3382	1.4026	1.4693	1.5386	1.6105	1.7623	2.0114
6	1.0615	1.1262	1.1941	1.2653	1.3401	1.4185	1.5007	1.5869	1.6771	1.7716	1.9738	2.3131
7	1.0721	1.1487	1.2299	1.3159	1.4071	1.5036	1.6058	1.7138	1.8280	1.9487	2.2107	2.6600
8	1.0829	1.1717	1.2668	1.3686	1.4775	1.5938	1.7182	1.8509	1.9926	2.1436	2.4760	3.0590
9	1.0937	1.1951	1.3048	1.4233	1.5513	1.6895	1.8385	1.9990	2.1719	2.3579	2.7731	3.5179
10	1.1046	1.2190	1.3439	1.4802	1.6289	1.7908	1.9672	2.1589	2.3674	2.5937	3.1058	4.0456
11	1.1157	1.2434	1.3842	1.5395	1.7103	1.8983	2.1049	2.3316	2.5804	2.8531	3.4785	4.6524
12	1.1268	1.2682	1.4258	1.6010	1.7959	2.0122	2.2522	2.5182	2.8127	3.1384	3.8960	5.3503
13	1.1381	1.2936	1.4685	1.6651	1.8856	2.1329	2.4098	2.7196	3.0658	3.4523	4.3635	6.1528
14	1.1495	1.3195	1.5126	1.7317	1.9799	2.2609	2.5785	2.9372	3.3417	3.7975	4.8871	7.0757
15	1.1610	1.3459	1.5580	1.8009	2.0789	2.3966	2.7590	3.1722	3.6425	4.1772	5.4736	8.1371

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Table B.2 Future Value of 1 (2)

	Rate											
Periods	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	15%
16	1.1726	1.3728	1.6047	1.8730	2.1829	2.5404	2.9522	3.4259	3.9703	4.5950	6.1304	9.3576
17	1.1843	1.4002	1.6528	1.9479	2.2920	2.6928	3.1588	3.7000	4.3276	5.0545	6.8660	10.7613
18	1.1961	1.4282	1.7024	2.0258	2.4066	2.8543	3.3799	3.9960	4.7171	5.5599	7.6900	12.3755
19	1.2081	1.4568	1.7535	2.1068	2.5270	3.0256	3.6165	4.3157	5.1417	6.1159	8.6128	14.2318
20	1.2202	1.4859	1.8061	2.1911	2.6533	3.2071	3.8697	4.6610	5.6044	6.7275	9.6463	16.3665
25	1.2824	1.6406	2.0938	2.6658	3.3864	4.2919	5.4274	6.8485	8.6231	10.8347	17.0001	32.9190
30	1.3478	1.8114	2.4273	3.2434	4.3219	5.7435	7.6123	10.0627	13.2677	17.4494	29.9599	66.2118
35	1.4166	1.9999	2.8139	3.9461	5.5160	7.6861	10.6766	14.7853	20.4140	28.1024	52.7996	133.1755
40	1.4889	2.2080	3.2620	4.8010	7.0400	10.2857	14.9745	21.7245	31.4094	45.2593	93.0510	267.8635

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Table B.3 Present Value of an Annuity of 1 (1)

$$p=\left[1-\frac{1}{(1+i)^{n}}\right]/i$$

TABLE B.2

Present Value of an

	Rate											
Periods	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	15%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346	0.9259	0.9174	0.9091	0.8929	0.8696
2	1.9704	1.9416	1.9135	1.8861	1.8594	1.8334	1.8080	1.7833	1.7591	1.7355	1.6901	1.6257
3	2.9410	2.8839	2.8286	2.7751	2.7232	2.6730	2.6243	2.5771	2.5313	2.4869	2.4018	2.2832
4	3.9020	3.8077	3.7171	3.6299	3.5460	3.4651	3.3872	3.3121	3.2397	3.1699	3.0373	2.8550
5	4.8534	4.7135	4.5797	4.4518	4.3295	4.2124	4.1002	3.9927	3.8897	3.7908	3.6048	3.3522
6	5.7955	5.6014	5.4172	5.2421	5.0757	4.9173	4.7665	4.6229	4.4859	4.3553	4.1114	3.7845
7	6.7282	6.4720	6.2303	6.0021	5.7864	5.5824	5.3893	5.2064	5.0330	4.8684	4.5638	4.1604
8	7.6517	7.3255	7.0197	6.7327	6.4632	6.2098	5.9713	5.7466	5.5348	5.3349	4.9676	4.4873
9	8.5660	8.1622	7.7861	7.4353	7.1078	6.8017	6.5152	6.2469	5.9952	5.7590	5.3282	4.7716
10	9.4713	8.9826	8.5302	8.1109	7.7217	7.3601	7.0236	6.7101	6.4177	6.1446	5.6502	5.0188
11	10.3676	9.7868	9.2526	8.7605	8.3064	7.8869	7.4987	7.1390	6.8052	6.4951	5.9377	5.2337
12	11.2551	10.5753	9.9540	9.3851	8.8633	8.3838	7.9427	7.5361	7.1607	6.8137	6.1944	5.4206
13	12.1337	11.3484	10.6350	9.9856	9.3936	8.8527	8.3577	7.9038	7.4869	7.1034	6.4235	5.5831
14	13.0037	12.1062	11.2961	10.5631	9.8986	9.2950	8.7455	8.2442	7.7862	7.3667	6.6282	5.7245
15	13.8651	12.8493	11.9379	11.1184	10.3797	9.7122	9.1079	8.5595	8.0607	7.6061	6.8109	5.8474

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Table B.3 Present Value of an Annuity of 1 (2)

Rate												
Periods	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	15%
16	14.7179	13.5777	12.5611	11.6523	10.8378	10.1059	9.4466	8.8514	8.3126	7.8237	6.9740	5.9542
17	15.5623	14.2919	13.1661	12.1657	11.2741	10.4773	9.7632	9.1216	8.5436	8.0216	7.1196	6.0472
18	16.3983	14.9920	13.7535	12.6593	11.6896	10.8276	10.0591	9.3719	8.7556	8.2014	7.2497	6.1280
19	17.2260	15.6785	14.3238	13.1339	12.0853	11.1581	10.3356	9.6036	8.9501	8.3649	7.3658	6.1982
20	18.0456	16.3514	14.8775	13.5903	12.4622	11.4699	10.5940	9.8181	9.1285	8.5136	7.4694	6.2593
25	22.0232	19.5235	17.4131	15.6221	14.0939	12.7834	11.6536	10.6748	9.8226	9.0770	7.8431	6.4641
30	25.8077	22.3965	19.6004	17.2920	15.3725	13.7648	12.4090	11.2578	10.2737	9.4269	8.0552	6.5660
35	29.4086	24.9986	21.4872	18.6646	16.3742	14.4982	12.9477	11.6546	10.5668	9.6442	8.1755	6.6166
40	32.8347	27.3555	23.1148	19.7928	17.1591	15.0463	13.3317	11.9246	10.7574	9.7791	8.2438	6.6418

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Table B.4 Future Value of an Annuity of 1 (1)

$$fi = \left[(1+)^{n} - 1 \right] / i$$

TABLE B.4

Future Value of an Annuity of 1

Periods	Rate											
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	15%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0100	2.0200	2.0300	2.0400	2.0500	2.0600	2.0700	2.0800	2.0900	2.1000	2.1200	2.1500
3	3.0301	3.0604	3.0909	3.1216	3.1525	3.1836	3.2149	3.2464	3.2781	3.3100	3.3744	3.4725
4	4.0604	4.1216	4.1836	4.2465	4.3101	4.3746	4.4399	4.5061	4.5731	4.6410	4.7793	4.9934
5	5.1010	5.2040	5.3091	5.4163	5.5256	5.6371	5.7507	5.8666	5.9847	6.1051	6.3528	6.7424
6	6.1520	6.3081	6.4684	6.6330	6.8019	6.9753	7.1533	7.3359	7.5233	7.7156	8.1152	8.7537
7	7.2135	7.4343	7.6625	7.8983	8.1420	8.3938	8.6540	8.9228	9.2004	9.4872	10.0890	11.0668
8	8.2857	8.5830	8.8923	9.2142	9.5491	9.8975	10.2598	10.6366	11.0285	11.4359	12.2997	13.7268
9	9.3685	9.7546	10.1591	10.5828	11.0266	11.4913	11.9780	12.4876	13.0210	13.5795	14.7757	16.7858
10	10.4622	10.9497	11.4639	12.0061	12.5779	13.1808	13.8164	14.4866	15.1929	15.9374	17.5487	20.3037
11	11.5668	12.1687	12.8078	13.4864	14.2068	14.9716	15.7836	16.6455	17.5603	18.5312	20.6546	24.3493
12	12.6825	13.4121	14.1920	15.0258	15.9171	16.8699	17.8885	18.9771	20.1407	21.3843	24.1331	29.0017
13	13.8093	14.6803	15.6178	16.6268	17.7130	18.8821	20.1406	21.4953	22.9534	24.5227	28.0291	34.3519
14	14.9474	15.9739	17.0863	18.2919	19.5986	21.0151	22.5505	24.2149	26.0192	27.9750	32.3926	40.5047
15	16.0969	17.2934	18.5989	20.0236	21.5786	23.2760	25.1290	27.1521	29.3609	31.7725	37.2797	47.5804

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Table B.4 Future Value of an Annuity of 1 (2)

	Rate											
Periods	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	12%	15%
16	17.2579	18.6393	20.1569	21.8245	23.6575	25.6725	27.8881	30.3243	33.0034	35.9497	42.7533	55.7175
17	18.4304	20.0121	21.7616	23.6975	25.8404	28.2129	30.8402	33.7502	36.9737	40.5447	48.8837	65.0751
18	19.6147	21.4123	23.4144	25.6454	28.1324	30.9057	33.9990	37.4502	41.3013	45.5992	55.7497	75.8364
19	20.8109	22.8406	25.1169	27.6712	30.5390	33.7600	37.3790	41.4463	46.0185	51.1591	63.4397	88.2118
20	22.0190	24.2974	26.8704	29.7781	33.0660	36.7856	40.9955	45.7620	51.1601	57.2750	72.0524	102.4436
25	28.2432	32.0303	36.4593	41.6459	47.7271	54.8645	63.2490	73.1059	84.7009	98.3471	133.3339	212.7930
30	34.7849	40.5681	47.5754	56.0849	66.4388	79.0582	94.4608	113.2832	136.3075	164.4940	241.3327	434.7451
35	41.6603	49.9945	60.4621	73.6522	90.3203	111.4348	138.2369	172.3168	215.7108	271.0244	431.6635	881.1702
40	48.8864	60.4020	75.4013	95.0255	120.7998	154.7620	199.6351	259.0565	337.8824	442.5926	767.0914	1,779.0903

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End of Appendix B

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